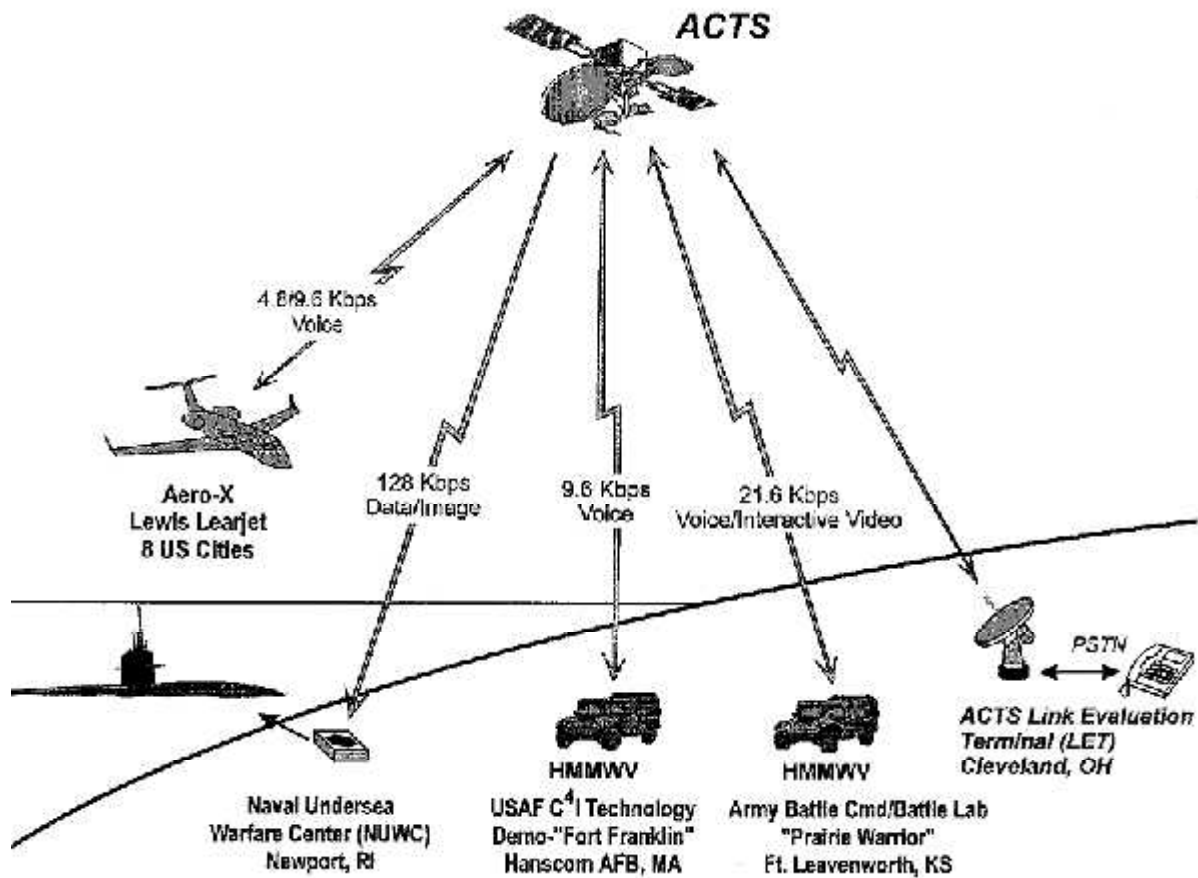


# Monolithic Microwave Integrated Circuit (MMIC) Phased Array Demonstrated With ACTS



*MMIC phased-array demonstration with ACTS.*

Monolithic Microwave Integrated Circuit (MMIC) arrays developed by the NASA Lewis Research Center and the Air Force Rome Laboratory were demonstrated in aeronautical terminals and in mobile or fixed Earth terminals linked with NASA's Advanced Communications Technology Satellite (ACTS). Four K/Ka-band experimental arrays were demonstrated between May 1994 and May 1995. Each array had GaAs MMIC devices at each radiating element for electronic beam steering and distributed power amplification. The 30-GHz transmit array used in uplinks to ACTS was developed by Lewis and Texas Instruments. The three 20-GHz receive arrays used in downlinks from ACTS were developed in cooperation with the Air Force Rome Laboratory, taking advantage of existing Air Force integrated-circuit, active-phased-array development contracts with the Boeing Company and Lockheed Martin Corporation.

Four demonstrations, each related to an application of high interest to both commercial

and Department of Defense organizations, were conducted. The figure shows the location, type of link, and the data rate achieved for each of the applications. In one demonstration--an aeronautical terminal experiment called AERO-X--a duplex voice link between an aeronautical terminal on the Lewis Learjet and ACTS was achieved. Two others demonstrated duplex voice links (and in one case, interactive video links as well) between ACTS and an Army high-mobility, multipurpose wheeled vehicle (HMMWV, or "humvee"). In the fourth demonstration, the array was on a fixed mount and was electronically steered toward ACTS. Lewis served as project manager for all demonstrations and as overall system integrator. Lewis engineers developed the array system including a controller for open-loop tracking of ACTS during flight and HMMWV motion, as well as a laptop data display and recording system used in all demonstrations. The Jet Propulsion Laboratory supported the AERO-X program, providing elements of the ACTS Mobile Terminal.

The successful performance of experimental, proof-of-concept MMIC K/Ka-band arrays developed with U.S. industry in field demonstrations with ACTS indicates that high-density MMIC integration at 20 and 30 GHz is indeed feasible. The successful development and demonstration of the MMIC array systems was possible only because of significant intergovernmental and Government/industry cooperation and the high level of teamwork within Lewis. The results provide a strong incentive for continuing the focused development of MMIC-array technology for satellite communications applications, with emphasis on packaging and cost issues, and for continuing the planning and conducting of other appropriate demonstrations or experiments of phased-array technology with ACTS.

Given the present pressures on reducing funding for research and development in Government and industry, the extent to which this can be continued in a cooperative manner will determine whether MMIC array technology will make the transition from the proof-of-concept level to the operational system level.